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Original Research Article

A comparative study on pulmonary function tests in smokers & nonsmokers

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ABSTRACT

Introduction: Cigarette smoking leads to development of cancers, cardiovascular, respiratory diseases including COPD. It poses a health challenge in reducing morbidity and mortality in developing countries like India. Spirometry in smokers may show reduction in lung function parameters.

Materials and Methods: A cross-sectional study was conducted in a tertiary healthcare level institute in Greater Noida on 100 smokers and 100 Nonsmokers total 200 healthy asymptomatic male subjects. Spirometry by RMS Helios spirometer 401 was conducted according to American Thoracic society guidelines after enrolling the subject based on inclusion and exclusion criteria and collected data was analysed with epi info 7 software using appropriate statistical methods.

Results: Smokers and Nonsmokers were not much different in mean age and other physical parameters. Pulmonary function parameters like FVC, FEV1, FEV1/FVC, PEFR, FEF are significantly less in Smokers as compared to Nonsmokers. With increasing smoking index (duration in years x number of cigarettes smoked per day) heavy smokers showed greater decline in lung function FVC and FEV1 like they showed with increasing age.

Conclusion: All the lung function test parameters show a significant decline in asymptomatic Smokers as compared to Nonsmokers. Therefore, by conducting spirometry, especially in smokers, cases may be detected at early stage and subsequent morbidity may be lessened.

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1. Introduction

The World Health Organization (WHO) reported that tobacco smoking killed 100 million people worldwide in the 20th century and warned that it could kill one billion people around the world in the 21st century also.¹ By the early 2030, tobacco related death would increase to about 10 million a year. In India smoking is a common habit prevalent in both urban and rural areas irrespective of mode of smoking i.e., cigarettes, bidis, pipes, cigar, hookah etc. Tobacco has remained as one of the most important predisposing factors responsible for so many respiratory and cardiovascular diseases.² Tobacco smoke contains 400 chemicals, out of which 60 are known carcinogens, which can lead to lung cancer. Smoking leads to rapid decline in

pulmonary function tests (PFTs). Smoking is the single most significant risk factor contributing to the development of COPD. Chronic Obstructive Pulmonary Diseases (COPD) has been recognized as one of the most important causes of morbidity and mortality in chronic tobacco smokers. In COPD, small airways are less than 2mm in diameter. These obstructions in airways invariably affect the parameters of pulmonary function. E.g., Forced vital capacity (FVC) and Forced Expiratory Volume in the First Second (FEV1). On an average, cigarette smokers have a high annual rate of decline in FEV1 of about 50 ml, which is nearly double the average value of 30 ml annually present in non-smokers.³ Pulmonary function testing is a routine procedure for the assessment and monitoring of respiratory diseases. Tests are also useful because they are less expensive, non-invasive, reproducible, and cause minimum discomfort to the subjects. Spirometric values vary according to age,

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height, sex, and body size. Thus, cigarette smoking has extensive effects on respiratory function, which can be detected with pulmonary function test. The aim of the study was to compare the pulmonary function among smokers and non-smokers.

The pulmonary functions tests may indicate deterioration of respiratory function before appearance of clinical symptom. This may be more profound in National Capital region more so, as it is one of the most polluted area in our country.

The cross-sectional study was conducted to compare the difference in pulmonary functions in Smokers & Non-smokers.

2. Materials and Methods

A cross-sectional study was conducted in the department of Physiology of Tertiary level health care institute in Greater Noida from June 2019 to November 2019. A total of 200 male subjects were included in the study including 100 smokers and 100 Nonsmokers who visited or working in the institution. A pretested semi-structured questionnaire was used to gather information regarding smoking habits, occupation, medical history etc. The individuals were enrolled in the study as per the following inclusion & exclusion criteria.

2.1. Inclusion criteria

1. Non-smoker: According to definition non-smoker is a person who does not smoke tobacco.
2. Smoker: They are persons who are engaged in the inhalation and exhalation of fumes of burning tobacco from cigarette. Every smoker must have been smoking at least one cigarette a day for one year.
3. Age 18-60 years.

2.2. Smoking index

The Smoking index for an individual was equal to multiplication of the average number of cigarettes smoked per day and duration (in years) of smoking further, smokers were classified as per exposure level, on the basis of smoking index criteria.

Habit smoking index (frequency x duration)

Nonsmoker 0

Light smoker 1 – 100

Moderate smoker 101 – 200

Heavy smoker > 200

2.3. Exclusion criteria

1. Those suffering from respiratory or cardiovascular diseases like bronchial asthma, pulmonary tuberculosis, Pleurisy, chronic obstructive airway disease.

2. The person who have history of cough with sputum, haemoptysis or are ill.
3. The person with occupational history of working in mills and factories or other places where lungs are affected by dust or fumes.
4. Those with a history of hospitalization with chronic ailment.

Spirometric manoeuvre, for evaluating the respiratory functions RMS Helios 401 Spirometer was used. The subjects were asked to sit comfortably on a chair. The complete procedure was explained and the subjects were instructed to breathe in fully by deep inspiration with their nostrils closed, to seal their lips around the sterile mouthpiece of the spirometer and to forcefully expire air out. The three consecutive readings were recorded and best of the three was used for the study.

Following activities were avoided prior to test, according to American thoracic society (ATS). Smoking within 1 hour of testing; Consuming alcohol within 4 hours of testing; Performing vigorous exercise within 30 mins of testing; Wearing clothing that substantially restricts full chest and abdominal expansion; Eating a large meal within 2 hours of testing.

The ethical clearance was obtained from the institutional ethical committee and data was collected & the results were analysed with epi info 7 software using appropriate statistical methods.

3. Results

In the present cross-sectional study 100 smoker male and 100 Nonsmokers male subjects between age 18 years and 60 years were studied for pulmonary function tests. No female smokers were included in the study as there were only 3 asymptomatic female smokers (less prevalence of smoking in Indian females and concealment of smoking due to social reasons) and statistical analysis was not possible with such a small number.

Table 1: Age and sex distribution

Physical characteristic	Nonsmoker male (Mean±SD)	Smokers male (Mean±SD)
Age(years)	36± 8.12	39±8.65
Height (in centimetres)	159.64± 0.51	160.25±0.46
BMI	23.84±0.32	24.21±0.40

Table 2: Distribution according to smoking index

Smoking index	Number	%
0-100	48	48
101-200	19	19.00
> 200	33	33

Table 3: Pulmonary function status according to duration of smoking (Mean±SD)

Duration	FVC	FEV1
5-10 years	2.94±0.43	2.57±0.41
11-15 years	2.87±0.40	2.44±0.37
16-20 years	2.83±0.43	2.32±0.43
21-25 years	2.94±0.47	2.35±0.39
> 25 years	2.66±0.41	2.09±0.32

Table 4: Comparison of pulmonary functions in different age groups in smokers & nonsmokers (Mean±SD)

Age group (in years)	FVC smokers	FEV1 smokers	FVC non-smokers	FEV1 non-smokers
≤20	2.89±0.38	2.50±0.41	2.85±0.38	2.43±0.41
21-30	3.10±0.78	2.79±0.57	2.96±0.44	2.52±0.41
31-40	2.69±0.62	2.21±0.63	2.96±0.40	2.46±0.34
41-50	2.82±0.44	2.37±0.46	2.79±0.40	2.26±0.34
51-60	2.66±0.50	2.10±0.50	2.59±0.43	2.07±0.31

Table 5: Comparison of different parameters of pulmonary function test in smokers and nonsmokers (mean ± SD)

Pulmonary Functions	Smokers N= 100	Non-smokers N= 100	Inference
FVC	2.89±.54	3.12±.53	significant < .05
FEV1	2.34±.41	2.73±.41	significant< .001
FEV1/FVC	82%± 8.60	87.5%± 6.80	Significant< .05
PEFR	6.16±.099	5.45±068	significant< .05
FEF25-75	3.39±.62	3.84±.63	significant < .001
FEF2-12	5.64±.92	6.51±1.05	significant < .001
FEF25	6.43±.67	7.54±.44	significant < .001
FEF50	4.71±.67	5.50±.54	significant < .001
FEF75	2.34±.52	2.66±.64	significant < .001

Physical characteristics of smokers and Nonsmoker are shown in Table 1. In the present study the age range of subjects was 18-60 years with 36 years mean age years in smokers and 39 years in Nonsmoker. In this study, there was no significant difference in the mean physical parameters like age, height, weight thereby showing proper matching of smokers and non-smokers.

Mild smokers were maximum in number (47.50%) followed by severe smokers (33.50%) and moderate smokers (19%) based on smoking Index (Table 2). Smoking index < 100 were considered mild smokers and > 200 were considered severe smokers.

In addition, a there was difference in lung functions found between duration of smoking, participant age and lung function parameters (Table 3 & Table 4). These results indicate that a decrease in lung function in different age groups is correlated conversely with smoking duration and participant age. Cigarettes smoked per day and lung function parameters (FVC, FEV1). These findings suggest that smoking duration and participant age could adversely affect lung capacity by reducing the volume associated with the FVC and FEV1.

The mean values of all the pulmonary function tests are significantly reduced in smokers compared to non-smokers. Pulmonary function parameters such as FVC, FEV1, PEFR, FEV1/FVC, FEF 25-75%, show a highly substantial

decrease in smokers compared to the non-smokers. All parameters like FEV1, FVC, PEFR, FEV1/FVC, forced expiratory flow (FEF) 25-75% are significantly decreased in cigarette smokers as compared to non-smokers. The association of impaired PFT in smokers was found to be statistically highly significant by applying unpaired t test of significance. Most of the non-smokers (96.0%) had normal PFT results.

4. Discussion

In recent times pulmonary function tests have evolved from tools for physiologic studies to clinical investigation in assessing respiratory status. They also become a part of routine health examination in respiratory, occupational, sports medicine and public health screening. FVC, FEF, PEFR, FEV1, FEV /FVC ratio were the pulmonary function tests selected for the present study.

In this study, there was no significant difference in the mean physical parameters like age, height, weight, and body mass index between the different groups thereby showing proper matching of smokers and non-smokers (Table 1). PFT analysis shows that smoking causes pulmonary functional impairments among smokers. The values of FVC, FEV1, PEFR, FEV1/FVC, and FEF 25-75% show a significant reduction in smokers compared with the

non-smokers (Table 5). In the previous studies by Dhand et al.,³ Bano et al.,⁴ Burrow et al.⁵ Gosavi et al.⁶ and Gupta et al.⁷ other similar studies^{8–10} the above parameters were significantly reduced in smokers as compared to the non-smokers. While Gupta et al. and Malo et al.¹¹ and Mahajan et al.,¹² Vyas et al. found no significant difference in FVC in the two groups.

Normal standards for the healthy non-smoker adults were established FVC FEV1, FEV₁/FVC ratio FEF, and PEFR values were found to be significantly lower in smokers than in non-smokers. All parameters of pulmonary function tests were markedly lower in smokers compare to that in non-smokers in all age groups (Table 4). Decline in all parameters of pulmonary function tests were seen when there is an increase in smoking index (no. of cigarette smoked x duration of smoking) (Table 3). Dhand et al.,³ Bano et al.⁴ observed similar pattern of reduction of Pulmonary functions with smoking index. The fall in FEV₁, PEFR and other flow rates indicate obstructive lung changes and fall in FVC indicates restrictive lung changes.

There was significant difference in FEF value in two groups indicating small airway involvement similar to the results published by Angelo MT.¹³

Possible mechanism for this could be accumulation of inflammatory exudates, excess mucus secretion, altered surface tension or altered smooth muscle tone. Mediators released from cells present in or brought to the airway could contribute to these changes. The progressive nature of these changes with continued smoking indicates that at least a proportion of these smokers develop chronic obstructive airways diseases. Human body has tremendous reserve to cope with adversities. Disability develops only when impairment has progressed up to a certain level.

5. Conclusions

Cigarette smoking has significantly deleterious effects on the pulmonary functions. Almost all the pulmonary function parameters are adversely affected in smokers much before the development of COPD and other complications of Smoking. Therefore, pulmonary functions in adults should be carried out specially in smokers so that cessation from smoking may be encouraged and morbidity is lessened.

6. Source of Funding

None.

7. Conflict of Interest

The authors declare that there is no conflict of interest.

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